

Application No. 10/660,379

Reply to Office Action

*REMARKS/ARGUMENTS**The Pending Claims*

The pending claims are directed to chemical-mechanical polishing compositions comprising fumed silica particles, a liquid carrier, and at least one alkaline earth metal selected from the group consisting of calcium, strontium, and barium, as well as methods of polishing a substrate using the same. Claims 1-98 currently are pending. Reconsideration of the claims is respectfully requested in view of the remarks herein.

Discussion of the Claim Amendments

Claims 1, 21, 43, and 64 have been amended to delete the limitation that the polishing compositions recited therein comprise a corrosion inhibitor. Claims 9, 30, 52, and 74 have been amended accordingly to recite that the polishing compositions recited therein further comprise a corrosion inhibitor selected from a specified group. These claim amendments serve to return these claims to their originally filed form. Accordingly, no new matter has been added by way of these claim amendments.

Summary of the Office Action

The Office Action rejects claims 1-98 under 35 U.S.C. § 103(a) as allegedly unpatentable over U.S. Patent 6,679,929 (Asano et al.) (hereinafter "the Asano '929 patent").

Discussion of the Obviousness Rejections

The Asano '929 patent generally discloses a polishing composition comprising an abrasive, an aliphatic carboxylic acid, at least one basic compound, at least one polishing accelerating compound, at least one anticorrosive agent, hydrogen peroxide, and water. The abrasive is selected from the group consisting of silicon dioxide, aluminum oxide, cerium oxide, zirconium oxide, and titanium oxide. The Asano '929 patent further provides that the basic compound is selected from the group consisting of an ammonium salt, an alkali metal salt, an alkaline earth metal salt, an organic amine compound, and a quaternary ammonium salt. The Office Action acknowledges that the Asano '929 patent fails to disclose (a) the specific usage of salts of calcium, barium, or strontium as the salts of the alkaline earth metals, and (b) the use of fumed silica as the abrasive particles.

There is nothing in the Asano '929 patent that would suggest to, or motivate, one of ordinary skill in the art to select the particular metals of calcium, strontium, and/or barium, in combination with the particular abrasive of fumed silica, for use in polishing compositions and methods. The Asano '929 patent fails to disclose or suggest any particular advantage of the specific combination of (a) an alkaline earth metal selected from the group consisting of calcium, barium, and strontium and (b) fumed silica. Indeed, the Asano '929 patent teaches

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that (a) the basic compound could well be something other than an alkaline earth metal salt and preferably is tetramethylammonium hydroxide (see, e.g., the Asano '929 patent at col. 4, lines 30-47) and (b) the abrasive preferably is colloidal silica (see, e.g., the Asano '929 patent at col. 3, lines 58-59). Since nothing within the Asano '929 patent would lead the ordinarily skilled artisan to select calcium, barium, and/or strontium from the list of basic compounds disclosed therein, and to combine it with fumed silica, the claimed invention cannot be considered obvious in view of the Asano '929 patent.

The Office Action asserts that it would have been obvious to one skilled in the art to employ salts of calcium, barium, or strontium as the source of the alkaline earth metal salts in the polishing composition disclosed in the Asano '929 patent inasmuch as calcium, barium, and strontium are all well known alkaline earth metals. The fact that something *can* be done, however, is not the proper standard for evaluating obviousness. There must be a teaching or suggestion *to do* that something, which teaching or suggestion must exist in the prior art. Here, there is nothing leading one of ordinary skill in the art to make the selection necessary from among the many possibilities disclosed in the Asano '929 patent so as to arrive at the claimed invention.

The unexpected improvement in polishing performance discovered for calcium, barium, and strontium in combination with fumed silica further emphasizes the unobviousness of the invention as recited in the pending claims in view of the disclosure of the Asano '929 patent. In particular, Applicants unexpectedly found that polishing compositions comprising fumed silica and salts of calcium, barium, and strontium *but not magnesium*, which is another alkaline earth metal, provide for enhanced removal rates in the polishing of tantalum-containing substrates. Example 1 of the present application compares the removal rates observed for several polishing compositions comprising fumed silica and several metal salts when used to polish a substrate comprising tantalum. In particular, a polishing composition containing 0.50 mmoles/kg of calcium exhibited a tantalum removal rate of 608 Å/min, whereas a polishing composition containing 0.82 mmoles/kg of magnesium exhibited a tantalum removal rate of only 113 Å/min. Further, Example 4 of the present application illustrates the removal rates observed for polishing compositions containing fumed silica and salts of calcium, barium, or strontium as well as a control polishing composition not containing appreciable amounts of the same. The removal rates observed for polishing compositions containing calcium, barium, or strontium salts are all at least 6.4 times the removal rate observed for the control polishing composition. Thus, the results set forth in Examples 1 and 4 demonstrate the unexpected properties of polishing compositions containing calcium, barium, and strontium as compared to similar polishing compositions containing magnesium or no alkaline earth metal.

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The unobviousness of the claimed invention is further evidenced by the accompanying Rule 132 Declaration of David J. Schroeder, one of the inventors of the claimed invention. The Rule 132 Declaration sets forth experimental data comparing the effects of the addition of calcium ion to polishing compositions containing fumed silica, precipitated silica, or fumed alumina on the removal rate observed when the polishing compositions were used to polish a tantalum substrate. As can be seen from the results of the polishing experiments, the addition of calcium ion to polishing compositions containing precipitated silica or fumed alumina resulted in a negligible effect on the removal rate of tantalum observed with such polishing compositions. By way of contrast, the addition of 40 ppm of calcium ion to polishing compositions containing fumed silica resulted in dramatic enhancements in the removal rates of tantalum as compared to the removal rates observed for polishing compositions containing fumed silica and no added calcium ion, the removal rates being 7.1 and 7.9 times greater for the two samples of fumed silica tested.

In view of the foregoing, the invention defined by the pending claims cannot properly be considered obvious over the Asano '929 patent. The combination of an alkaline earth metal selected from the group consisting of calcium, barium, and strontium with fumed silica could only be accomplished from the general disclosure of the Asano '929 patent through the use of improper hindsight knowledge of the present invention. Moreover, the unexpected results exhibited by the claimed invention are sufficient to rebut any allegation of obviousness based on the Asano '929 patent. The obviousness rejection, therefore, should be withdrawn.

As noted above, claims 1, 21, 43, and 64 have been amended to delete the recitation that the polishing compositions recited therein comprise a corrosion inhibitor. This recitation was added to these claims in connection with a response to the Office Action dated February 3, 2005, which Office Action rejected claims 1, 21, 43, and 64 as being unpatentable in view of Japanese Patent Publication No. 11-080707 (Suzumura et al.) (hereinafter "the Suzumura '707 publication") and Japanese Patent Publication No. 11-080708 (Suzumura et al.) (hereinafter "the Suzumura '708 publication"). The recitation is being removed from these claims because it unduly restricts the invention as defined by those claims and is not necessary to define a patentable invention in view of the cited references.

The Suzumura publications are generally directed to a polishing composition comprising (1) a polishing material, (2) 0.001-0.15 mol/L of at least one cation selected from the group consisting of ammonium ions, alkali metallic ions, and alkaline earth metallic ions, and (3) water, wherein the polishing material can be silicon dioxide, aluminum oxide, cerium oxide, titanium oxide, silicon nitride, zirconium dioxide, or manganese dioxide. There is nothing within the disclosures of the Suzumura publications that would suggest to, or motivate, one of ordinary skill in the art to select the particular metals of calcium, strontium,

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and/or barium, in combination with the particular abrasive of fumed silica, for use in polishing compositions and methods. Thus, the present invention is patentable over the disclosures of the Suzumura publications for the same reasons discussed above that the present invention is patentable over the disclosure of the Asano '929 patent.

Furthermore, the Suzumura publications disclose that the cation is preferably selected from the group consisting of ammonium, lithium, sodium, potassium, beryllium, magnesium, and calcium (see, e.g., the Suzumura '707 publication at paragraph [0032] and the Suzumura '708 publication at paragraph [0030] of the computer translations of the Suzumura publications available at the Japanese Patent Office web site). As discussed above with respect to the Asano '929 patent, Applicants have unexpectedly found that polishing composition comprising fumed silica and salts of calcium, barium, and strontium *but not* magnesium, provide for enhanced rates in the polishing of tantalum-containing substrates. Insofar as the Suzumura publications suggest that magnesium and calcium are equally suitable for use in the disclosed polishing compositions, one of ordinary skill in the art would not have expected such a dramatic difference in the tantalum removal rates exhibited by similar polishing compositions comprising calcium and magnesium. This is yet another reason why the present invention, as defined by the pending claims, is patentable over the disclosures of the Suzumura publications and why the prior obviousness rejection based on the Suzumura publications should not be reinstated despite the amendment to return claims 1, 21, 43, and 64 to their originally filed form.

Conclusion

The application is considered in good and proper form for allowance, and the Examiner is respectfully requested to pass this application to issue. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

Respectfully submitted,


John Kilyk, Jr., Reg. No. 30,763
LEYDIG, VOIT & MAYER, LTD.
Two Prudential Plaza, Suite 4900
180 North Stetson Avenue
Chicago, Illinois 60601-6780
(312) 616-5600 (telephone)
(312) 616-5700 (facsimile)

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